REMARKS/ARGUMENTS

Claims 39-45 and 47-80 are presently pending in this case. Claims 57-77 are withdrawn. Claims 39 and 54, the independent claims are reproduced below for reference:

> Claim 39: A heat spreader comprising:
> a layer of CVD diamond grown onto a diamond loaded (DL) material, the DL material comprising a mass of diamond particles in a matrix and having a surface with exposed diamond particles on which the layer of CVD diamond is grown, the diamond particles having a diameter of at least 10 μm,
> wherein the layer of CVD diamond is bonded to the exposed diamond particles of the DL material at least in part by epitaxy, and the grown layer of CVD diamond has an exposed surface with at least 30% of the exposed surface being occupied by diamond grains with a grain size of at least four times a thickness of the layer of CVD diamond.
>
> Claim 54: A heat spreader comprising:
> a layer of DL material having major surfaces on each of opposite sides thereof, the layer of DL material including diamond particles having a diameter of at least 10 μm; and
> a layer of CVD diamond in thermal contact with each of the major surfaces, with either one or both of the CVD diamond layers being bonded at least in part by epitaxy to exposed diamond particles of the DL material,
> wherein the layer of CVD diamond has an exposed surface with at least 30% of the exposed surface being occupied by diamond grains with a grain size of at least four times a thickness of the layer of CVD diamond.

Applicants thank Examiner Miller and Examiner Zimmerman for the courtesy of meeting with their undersigned representative on March 23, 2009 to discuss the issues raised in the Action. During this discussion, the differences between the claims and what is described in the cited documents was addressed. Briefly (with detailed discussion on these points following), it was explained that (A) one would not have combined the teachings of Deguchi and Ekstrom because it would not have been expected to work; and (B) even in combination Deguchi and Ekstrom do not result in a structure like that claimed.

There is a single rejection applied 35 U.S.C. §103 citing to Deguchi in view of Ekstrom that was maintained from a previous action.

In paragraph 5 of the office action the it is alleged that

> it would have been obvious to one having ordinary skill in the art to substitute the diamond particle and silicon containing composite material of Ekstrom with the silicon substrate in Deguchi in order to provide a substrate that has a thermal conductance exceeding metals and low thermal expansion advantageous in heat spreader.

The Applicants do not agree that this would be an obvious combination to make because Deguchi is concerned with producing a thin fine-grained continuous CVD layer from a plurality of fine nuclei. There is no incentive to make the combination with Ekstrom because if it were made it would not work, and one would not expect it to work. The reason for this is explained below.

If the combination were made (i.e. if the diamond particle and silicon containing composite material of Ekstrom is substituted for the silicon substrate in Deguchi), then the resulting structure would be one in which large numbers ($>10^{10}$per cm^{2-} - see column 2, line 53 of Deguchi) of very small diamond nuclei particles, that are critical to the method of Deguchi, would be distributed on or embedded in the diamond- and silicon-containing composite material of Ekstrom prior to the CVD process. This would not result in a layer of CVD diamond grown onto a DL material with exposed diamond particles of diameter of at least 10 μm with the CVD layer bonded to the exposed diamond particles at least in part by epitaxy, as required by the present invention as defined by the amended claims.

Given the large number of diamond nuclei particles on the surface ($>10^{10}$per cm^2), the diameter of each of these diamond nuclei particles would need to be very small indeed in order to fit that many nuclei on the surface . Ekstrom describes a diamond particle and silicon containing composite material in which a diamond mixture consisting of at least two different fractions with different diamond particle sizes is used, at least 50 weight percent

having a diameter of 80 μm or above, and the other particles having a minimum size of 6 μm (column 5, lines 34-40). Therefore given the density of diamond nuclei particles in Deguchi of $>10^{10}$per cm^2, and the fact that the diamond particles of the Ekstrom substrate (either 6 μm or 80 μm) would be so very much larger than the diamond nuclei of Deguchi that would be distributed on (or partially embedded in) their surface if the Deguchi/Ekstrom combination were made, then each diamond particle of the Ekstrom substrate would be covered by thousands of Deguchi diamond particle nuclei. This can be calculated as follows:

Assuming particles are circular and there are 10^{10} particles per cm^2, then the area per particle is $10^{-10}cm^2$.

A particle with a diameter of 6μm has an area of $(6x10^{-4})^2 x\ \pi/4$ = approx $2.8\ x10^{-7}$

Therefore each 6 μm large Ekstrom diamond particle would be covered with $(2.8\ x10^{-7})/\ 10^{-10}$= approx 2800 Deguchi diamond nuclei.

Carrying out a similar calculation for the 80 μm large diamond particles of Ekstrom, each of those large particles would be covered with approximately $5\ x\ 10^5$ Deguchi nuclei.

Applicants attach some rough drawings to illustrate these points (Figures A, B1, B2, C1 and C2).

Figure A illustrates what the Deguchi/Ekstrom combination would look like prior to CVD growth and Figures B1 and B2 illustrate what the combination would look like after CVD growth. In Figure A, the Deguchi nuclei are shown on rather than embedded in the substrate for simplicity. However, as argued by the Examiner in which the Deguchi nuclei are embedded in the surface is shown in Figures B1 and B2. The Figures are schematic since as calculated above the number of Deguchi nuclei on each large diamond Ekstrom particle surface would be many thousand, which it is not possible to illustrate in the figures.

As can be seen from Figures B1 and B2, growth from the surface would be dominated by the fine nuclei. There could be no direct growth epitaxially from the diamond particles in

the Ekstrom substrate since these would be substantially completely covered with the fine Deguchi nuclei, and growth from the Deguchi nuclei would crowd out any growth from the diamond particles in the Ekstrom substrate. See Claim 39 and the term "epitaxy" that defines the structure.

In contrast growth from the surface of the diamond loaded material of the present invention is illustrated in Figures C1 and C2 would includes direct epitaxial growth from the large diamond particles in the substrate, with smaller non-epitaxial growth occurring on the Si/SiC matrix sections between the large diamond particles in the Si/SiC matrix.

The present invention, as defined by Claim 39, requires:

> ...a layer of CVD diamond grown onto a DL material comprising.....a surface with exposed diamond particles on which surface the layer of CVD diamond is grown, the diamond particles having a diameter of at least 10 μm, wherein the layer of CVD diamond is bonded to the exposed diamond particles of the DL material at least in part by epitaxy....

This invention is not achieved by the Deguchi/Ekstrom combination as can be clearly seen by reference to Figures A and B. The fine diamond nuclei from which some epitaxial growth does take place are not "diamond particles having a diameter of at least 10 μm." The diamond particles in the diamond particle- and silicon-containing composite are larger than 10 μm, but no growth, epitaxial or otherwise, can occur from these particles which are covered by thousands of fine diamond nuclei which dominate growth in the CVD layer. Therefore the product provided by combining Deguchi and Ekstrom is not the invention as defined by Claim 39.

The rejection in paragraphs 6, 9 and elsewhere in the action refers to the thermal conductance and thermal expansion of the substrate in supporting the combination of Deguchi and Ekstrom. That is a misunderstanding of the issue. As is shown above, combining Deguchi and Ekstrom cannot lead to a product in which a CVD diamond layer is grown by epitaxy on exposed diamond particles of at least 10 μm in diameter, a key

characteristic of Claim 39 and the thermal properties of the substrate have no relevance in this regard.

The rejection in paragraphs 9 and 18 refers to Deguchi as recognizing the significance of grain size of the material and states that Deguchi teaches that diamond material can be used in films with larger grain sizes. From this it would seem that the rejection seeks to rely selectively on parts only of the Deguchi teachings. It is improper to modify Deguchi by leaving out the diamond nuclei (which are key to Deguchi) prior to combining it with Ekstrom. see MPEP § 2141.02 (prior art must be considered in its entirety, including disclosures that teach away from the claims) and MPEP § 2143.01 (proposed modification cannot render the prior art unsatisfactory for its intended purpose or change the principle of operation of a reference).

Applicants add, in this regard, that the reliance on the larger grained diamond material described in the Deguchi background of the invention is misplaced. The grain size referred to by Deguchi is a reference to the grain size in the grown diamond and not the grain size of the diamond in a substrate material, a feature of Claim 39.

While Ekstrom may teach that it is advantageous to have a large grain size in order to optimize thermal conductivity of a diamond containing material, there is nothing in Ekstrom or in Deguchi alone or in combination that would suggest that CVD deposition directly onto a Ekstrom type surface would result in direct growth of a thin CVD layer with large grain sizes not only through the bulk of the CVD layer, but importantly also at the nucleation surface of the CVD layer. The heat spreader of the prior art is therefore an elegant solution for providing a heat spreader and a distinct departure from the prior art.

Regarding paragraph 12 of the office action that the

> partial embedding of the diamond particles in to the surface of the substrate (as in Fig 4 of Deguchi)is considered deliberately enhanced epitaxy bonding

is not understood. Growth from the diamond nuclei particles will in itself be epitaxial (diamond growing on diamond), but this will not be affected by whether the nuclei is embedded or not. There can, of course, be no epitaxial bonding to the non diamond substrate of Deguchi, since the nuclei are randomly deposited on the surface.

In paragraph 21 of the Action, reference is made to the feature from Claim 39 that the grain size is four times the thickness of the CVD layer. This is the advantageous outcome of the present invention which results from there being exposed diamond particles having a diameter of at least 10 μm on the surface, onto which the CVD diamond layer is grown. This unique and new thin, but large grain, directly-grown layer is not disclosed nor suggested by Deguchi (which specifically wants to generate thin but fine grain continuous film) nor by Ekstrom (which is considered with a bulk material only), nor by the combination of the two references.

Reconsideration and withdrawal of the rejection is requested.

A Notice of Allowance is kindly requested.

Respectfully submitted,

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